

# Electricity & Heat

## Powering the Computer and Where that Power Goes

How Stuff Works – Power Supply

# Powering the Computer

All computers, whether desktop PCs or mobile devices, run on electricity. This electricity can be provided in a variety of ways

- wall outlets
- batteries
- solar power
- mechanical power



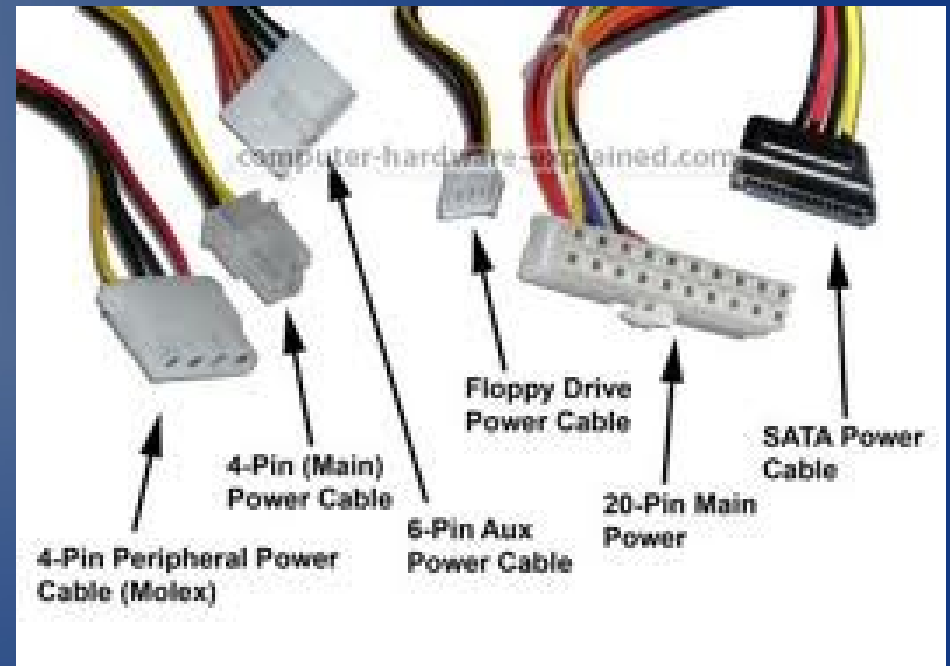
# Hydro-Electric Power (e.g., wall sockets)

- wall outlets are the most common method for powering computers
  - some portable computers rely on their battery, which must still be charged from the outlet
- in Canada, wall outlets provide 110-120 volts of alternating current (A/C)
- the power supply changes this to various direct current (D/C) voltages required by the various computer components



# Computer Voltage Requirements

- many of the components in a computer have different power requirements
- 120 V A/C must be changed to:
  - 3.3 V D/C
  - 5 V D/C
  - 12 V D/C



# Electrical Energy to Thermal Energy

- electricity is provided to the computer so that it can do "work"
- we may think of "work" as doing something useful, like a calculation or showing an image
- in physics, "work" is the same as "energy"
  - when a computer does useful work, it is also doing physics work
  - electrical energy is converted to thermal energy (heat)

# Managing Computer Heat

- in general, heat is bad for the special substances that are used to make computer components
  - these are called "semiconductors"
- to manage the heat generated within the computer, we use a combination of
  - active cooling
  - passive cooling

# Managing Computer Heat

## Active Cooling

- for active cooling, we actually use more electricity in the computer system to keep specific parts cooler
- certain components get much hotter than others
  - CPU, GPU, power supply
- electrical fans are placed throughout the computer to wash cool air (or a liquid!) over the hottest components
- generally combined with passive cooling



# Managing Computer Heat

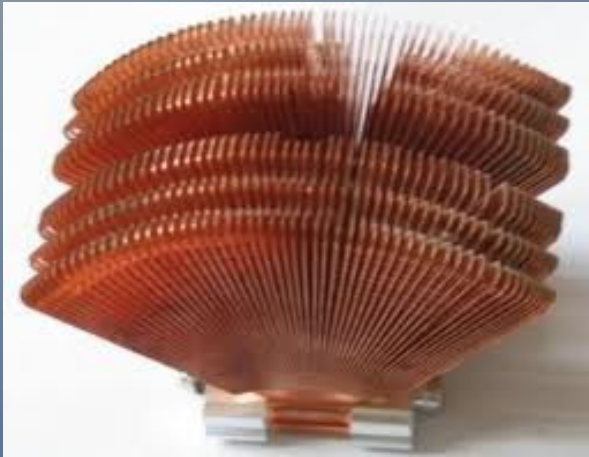
## Passive Cooling

- passive cooling does not require any power
- special materials (usually metals) are used to conduct heat away from hot components
  - these are called "heat sinks" because, just like a regular sink, the heat is drained away
- the internal layout of the computer is designed so air flows naturally over hot areas
- vents are cut into the computer case so fresh (cool) air enters and hot air exits



# Managing Computer Heat

## Active & Passive Cooling



# Computer Power Requirements

- each component of the computer requires power to run
- the power supply unit (PSU) will be rated to provide a maximum amount of power
- each component will be rated for its peak power requirement
  - peak power is the power used when the component is at maximum speed or load
- it is important to consider power requirements when building or modifying a system

# Computer Power Requirements

## Examples

- sample power supply units (PSU)
  - 250 W
  - 350 W
  - 500 W
  - 750 W
  - 1000 W
  - 1500 W
- intel i7 processors
  - 65 W to 150 W
- graphics cards
  - 70 W to 700 W
- computer case fan
  - consumes 4 W
  - dissipates 180 W of heat